(19) Europäis hes Patentamt
European Patent Office
Office uropéen d s brevets

(11) EP 0 742 113 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.11.1996 Bulletin 1996/46

(51) Int Cl.[6]: **B60G 11/46**, B60G 11/28, B62D 61/12, F16F 9/05

(21) Application number: **96201285.2**

(22) Date of filing: **10.05.1996**

(84) Designated Contracting States:
BE DE DK FR GB IT NL

(30) Priority: **11.05.1995 NL 1000342**

(71) Applicant: **WEWELER NEDERLAND B.V.**
7300 AC Apeldoorn (NL)

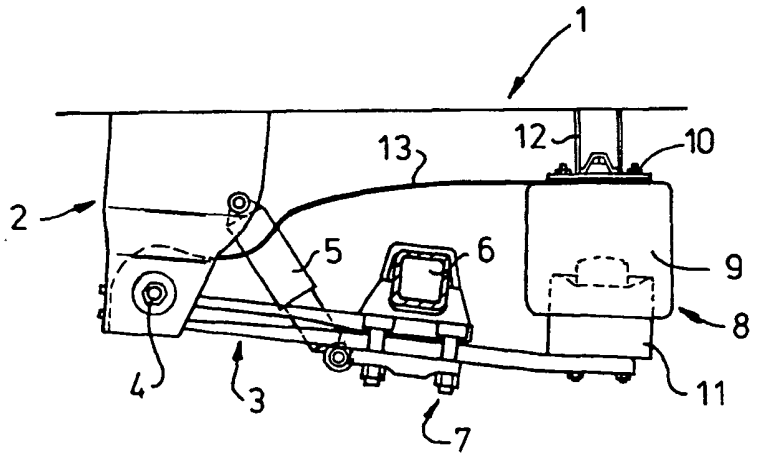
(72) Inventor: **Bramer, Hans**
6961 WR Eerbeek (NL)

(74) Representative: **de Bruijn, Leendert C. et al**
Nederlandsch Octroolbureau
P.O. Box 29720
2502 LS Den Haag (NL)

(54) Bellows, as well as air suspension system and axle lift system

(57) An air suspension system for a road vehicle, comprising an axle (6) having a trailing arm (3) close to each end, which trailing arms are each mounted on a spring hanger (2) which is attached to the chassis (1) of the road vehicle, a bellows (8) being provided between each trailing arm and the chassis, which bellows has a bellows rubber which is attached by means of a fixed fitting (11) to either the trailing arm or the chassis, and interacts in a disengaging manner with the other of these by means of a seating which permits only the transmission of compressive forces. The bellows rubber interacts, close to the seating, with positioning means (13) for holding the bellows rubber in a predetermined position.

Fig-1



EP 0 742 113 A1

Description

The invention relates to a bellows for a road vehicle, in particular for an air suspension system or for an axle lift system thereof, which bellows comprises a bellows rubber which at one end has a fitting which can be fixed to the road vehicle and at the other end has a free fitting which forms an unsecured seating and allows only the transmission of compressive forces.

A bellows of this type is known. The unsecured seating of the bellows makes it possible, in certain cases, to release the connection to that part of the road vehicle supported by the bellows. This provides the advantage that, when the road vehicle is lifted, the bellows provided as part of the air suspension system is not subjected to tensile force, which would cause it to fail.

The disadvantage of the known bellows is that when the normal operating position is restored, the free fitting is positioned incorrectly. The aim of the present invention is to provide a bellows which does not have this disadvantage. This aim is achieved in that the free fitting is provided with positioning means which can be fixed to the road vehicle to hold the bellows rubber in a predetermined position with respect to the road vehicle.

The invention also relates to an air suspension system for a road vehicle, comprising an axle having a trailing arm close to each end, which trailing arms are each mounted on a spring hanger which is attached to the chassis of the road vehicle, a bellows being provided between each trailing arm and the chassis, which bellows has a bellows rubber which is attached by means of a fixed fitting to either the trailing arm or the chassis, and interacts in a disengaging manner with the other of these by means of a seating which permits only the transmission of compressive forces.

When road vehicles which are provided with air suspension systems are transported by rail, regulations require that there should be no pressure in the bellows rubbers. The purpose of this regulation is to guarantee reliable, stable positioning of the road vehicle on the rail vehicle. However, as soon as the road vehicle with its unpressurised bellows rubbers is lifted, for example when lifting the road vehicle off a rail vehicle, said bellows rubbers roll out to their maximum length under the influence of the weight of the axle. When the vehicle is subsequently set down, the bellows rubbers will no longer roll in in the desired manner, but will be compressed with the formation of folds. This effect occurs to a more pronounced degree in the case of bellows which have a long stroke, the bellows rubbers of which are even more unstable.

An air suspension system of this type is disclosed in EP-A 554 573. The bellows rubber thereof is attached by a fixed fitting to the chassis of the road vehicle. A cone is provided on the trailing arm, which cone interacts in a disengaging fashion with a free fitting at the other end of the bellows rubber. As a consequence of this interaction between the cone and the free fitting, the bellows rubber of the bellows cannot be subjected to tensile force, even when the distance between trailing arm and chassis becomes relatively large. In practice, such a large distance usually occurs when lifting the vehicle in connection with placing it on a rail vehicle or boat.

When the vehicle is set down, the cone moves towards the free fitting and the free fitting has to come to rest again in the correct position on the cone. In order to obtain this interaction between these parts, the free fitting has to be held in a certain position. However, as the free fitting is attached to the supple bellows rubber, it has no clearly defined position as soon as the cone has disengaged from said fitting. There is therefore a certain risk that the bellows will not function properly after the vehicle has been set down.

In the case of the known air suspension system it would be possible for the free fitting to be held in a certain position by the rigidity of the bellows rubber. The problem, however, is that in practice it is not always possible to guarantee the same position at all times.

In the case of multiple-axle vehicles, such as trailers, the problem arises that the bellows rubbers of the various axles are not rolled in to the same degree if the trailer is tilting backwards. Furthermore, unevenness in the road can give rise to mutual differences in position of the bellows rubbers.

The aim of the invention is to provide an air suspension system which does not have these disadvantages. Said aim is achieved in that the bellows rubber interacts, close to the seating, with positioning means for holding the bellows rubber in a predetermined position.

With a bellows embodiment of this type, the free fitting can always be held in the correct position even when the bellows rubber is in the fully unpressurised state. This means that when the vehicle is set down it is always ensured that the bellows rubber is rolled in in the correct manner.

As mentioned above, the known air suspension system comprises a seating provided with a free fitting attached to the bellows rubber, as well as a counterpart attached to chassis or trailing arm, which free fitting and counterpart can be held pressed against one another by compressive forces. According to the invention, the free fitting can interact with elastic positioning means.

The invention also relates to a bellows for a road vehicle, in particular for an air suspension system or for an axle lift system thereof, which bellows comprises a bellows rubber which at one end has a fitting which is fixable to the road vehicle and at the other end has a free fitting which forms an unsecured seating and permits only the transmission of compressive forces. An axle lift system of this type is disclosed in EP-A 431 673. The bellows provided for lifting the axle is attached by means of a rigid spacer to the trailing arm or the spring hanger. Consequently, in operation the bellows is continually exposed to the suspension movements of the trailing arm, which could lead to fatigue in the bellows rubber.

A further aim of the invention is to provide an axle lift system which does not have this disadvantage. Said aim is achieved in that a bellows is provided, the bellows rubber of which interacts, close to the seating, with positioning means for holding the bellows rubber in a predetermined position.

The bellows in the axle lift system according to the invention can be disengaged from the trailing arm, such that it is at rest when the road vehicle is being driven. The positioning means ensure that the free fitting of the bellows is again pressed against the trailing arm in the correct position.

The positioning means can be fixed to the spring hanger. However, fixing to the trailing arm or fixing to the fixed fitting of the bellows is also possible.

Preferably, the positioning means exert a pretensioning force on the bellows rubber in the direction of its compressed state. As soon as the internal pressure in the bellows rubber falls or becomes zero, for any reason whatsoever, said bellows rubber will be compressed under the influence of the pretensioning force exerted by the positioning means. As has already been mentioned above, the compressed position is clearly defined. Moreover, in this position it is always ensured that the bellows rubber rolls in in the correct manner, without forming folds.

Said positioning means can be constructed in various ways. According to a first possible embodiment, an auxiliary leaf spring is provided, the rigidity of which is appreciably less than that of the trailing arms, which auxiliary spring is fixed by one end to the free fitting and at the other end is fixed to another part of the system.

Fixing of the auxiliary spring to the chassis or spring hanger has the advantage that, when the road vehicle is in normal operation on the road, said auxiliary spring does not have to follow the suspension movements of the vehicle if the fixed fitting is also fixed to the chassis.

This advantage is also achieved in the case of an alternative embodiment, wherein both the auxiliary spring and the fixed fitting are fixed to the trailing arm.

According to a further possible embodiment, a helical spring is provided, one end of which is fixed to the free fitting of the bellows and the other end of which is fixed to the fixed fitting of the bellows.

According to a further alternative, the positioning means can comprise an essentially non-elastic auxiliary arm which at one end is fixed to the free fitting of the bellows and at the other end is pivotably mounted.

The invention will be explained in more detail below with reference to a few illustrative embodiments shown in the figures.

Figures 1 - 4 show a first illustrative embodiment of the air suspension system according to the invention, in various positions.

Figures 5 - 7 show, respectively, second, third and fourth embodiments.

Figure 8 shows a fifth embodiment.

Figure 9 shows an axle lift system according to the invention.

The air suspension system shown in Figures 1 - 4 comprises, in a known manner, two spring hangers 2, in each of which a trailing arm 3 is mounted such that it is pivotable about pivot 4. Furthermore, a shock damper 5 is provided between each trailing arm 3 and spring hanger 2. The axle 6 is fixed to the two trailing arms 3 by means of the fastening 7 with straps and strap plates, which is likewise known per se.

Furthermore, the trailing arms 3 are each resiliently supported with respect to the chassis 1 by a bellows 8. Said bellows 8 comprises a bellows rubber 9, which at the top is provided with a fitting 10 which bears against a seating with respect to the chassis 1. At its lower end, the bellows rubber 9 is attached to a fitting (bellows piston) 11, which is fixed to the relevant trailing arm 3. Said lower fitting 11 is, in a known manner, in the shape of a cylinder, over which the bellows rubber 9 can roll.

Although the bellows rubber 9 is completely rolled in in the position in Figure 3, it is nevertheless possible to obtain a well defined position if the bellows rubber 9 is partially rolled in.

As can be seen in Figure 3, the upper fitting 10 is free from the chassis 1, in particular free from the counterpart 12 fixed to the chassis 1. The advantage of this unsecured interaction between upper fitting 10 and counterpart 12 is that during lifting of the road vehicle, for example when loading it onto or unloading it from a rail vehicle, the bellows rubber 9 cannot be stretched when axle 6, with the wheels fixed thereto, drops downwards.

In order, in this position, to hold the bellows rubber 9 and the upper fitting 10 in a position such that the bellows 8 is again able to function in the correct manner when the road vehicle is set down again, an auxiliary leaf spring 13 is provided. Said auxiliary leaf spring 13 is fixed at one end to the relevant spring hanger 2 and at the other end to the upper fitting 10. Furthermore, the auxiliary leaf spring 13 is constructed such that it exerts a certain pretensioning force on the upper fitting 10 and continually presses the latter downwards in the direction towards the associated trailing arm 3. The consequence of this is that, when the internal pressure in the

bellows 8 becomes low or zero, as is the case when the road vehicle is transported by boat or rail, the bellows rubber 9 is compressed in the indicated manner.

In this position it is always ensured that when the road vehicle is set down again, the fitting 10 again interacts in the correct manner with the counterpart 12.

Figure 2 shows the position in which the bellows 8 has reached its maximum stroke, for example in order to bring the loading floor of the road vehicle to the correct height in connection with loading or unloading thereof.

Figure 4 shows the minimum height of the bellows, likewise, for example, in connection with loading or unloading of the road vehicle.

As can be seen from Figures 1, 2 and 4, the auxiliary leaf spring used according to the invention is not exposed to the normal spring movements of the bellows 8 since, in the normal operating position of the road vehicle, it extends between two parts, that is to say spring hanger 2 and counterpart 12, which are fixed with respect to the chassis 1.

Figure 5 shows an embodiment in which the bellows 14 is permanently fixed to the chassis by means of the upper fitting 15 and interacts in an unsecured fashion with the trailing arm 3 by means of the lower fitting 16. The trailing arm 3 has a counterpart 17, which effects the interaction with the free fitting 16 of bellows 14. According to the invention, an auxiliary leaf spring 18 is now arranged between the trailing arm 3 and the lower, free fitting, which auxiliary leaf spring presses said lower, free fitting continually in the upward direction. With this embodiment, therefore, as soon as the pressure in bellows 14 has become sufficiently low or is zero the bellows rubber 19 will be pressed up on the lower, free fitting 16.

Figure 6 shows a variant of Figure 5, in which the auxiliary leaf spring 20 according to the invention is arranged between the fixed fitting 15 and the free fitting 16. In this embodiment also, the counterpart 17 is fixed to the trailing arm 3.

In the variant in Figure 7, which substantially corresponds to the embodiment according to Figures 1-4, the auxiliary leaf spring 21 according to the invention is fixed at one end to the chassis 1 and at the other end to the upper, free fitting 10 of the bellows 8.

The auxiliary leaf springs left and right can be coupled to one another.

In the variant in Figure 8, the auxiliary leaf spring 13 is attached by means of a pivot pin 30 to the spring hanger 2.

The axle lift system shown in Figure 9 comprises two spring hangers 2 which are fixed to a chassis of a road vehicle and each of which has a trailing arm 3, which together support an axle, the various features being as shown in Figures 1-8. A support 30 is fixed to each spring hanger 2, a bellows 31 being arranged between said support 30 and the associated trailing arm 3 in each case. The bellows rubber 33 is fixed to the support 30 via the fixed fitting 35 of the bellows 31; on lifting, the bellows 31 presses by means of the free fitting 34, in particular the stop 36 thereof, against the trailing arm 3.

According to the invention the free fitting 34 is fixed by means of leaf spring 32 to the spring hanger 30. With this arrangement the leaf spring 32 can exert a pretensioning force on the bellows 31 such that, in the absence of an overpressure, the bellows rubber 33 is compressed into the position indicated by broken lines.

The leaf spring 32 can also be hingeably attached to the spring hanger.

Claims

1. Bellows (8, 31) for a road vehicle, in particular for an air suspension system or for an axle lift system thereof, which bellows (8, 31) comprises a bellows rubber (9, 33) which at one end has a fitting (11, 35) which can be fixed to the road vehicle and at the other end has a free fitting (10, 34) which forms an unsecured seating and allows only the transmission of compressive forces, characterised in that the free fitting (10, 34) is provided with positioning means (13, 18, 20, 21, 32) which can be fixed to the road vehicle to hold the bellows rubber (9, 33) in a predetermined position with respect to the road vehicle.

2. Air suspension system for a road vehicle, comprising an axle (6) having a trailing arm (3) close to each end, which trailing arms (3) are each mounted on a spring hanger (2) which is attached to the chassis (1) of the road vehicle, a bellows (8, 14) being provided between each trailing arm (3) or the axle (6) and the chassis (1), which bellows (8, 14) has a bellows rubber (9, 19) which is attached by means of a fixed fitting (11, 15) to either the trailing arm (3) or the chassis (1), and interacts in a disengaging manner with the other of these by means of a seating which permits only the transmission of compressive forces, characterised in that a bellows according to Claim 1 is provided, the bellows rubber (9, 19) of which interacts, close to the seating, with positioning means (13, 18, 20, 21) for holding the bellows rubber (9, 19) in a predetermined position.

3. Air suspension system according to Claim 2, wherein the seating comprises a free fitting (10, 16) attached to the bellows rubber (9, 19), as well as a counterpart (12, 17) attached to chassis (1) or trailing arm (3), which free fitting (10, 16) and counterpart (12, 17) can be held pressed against one another when the road vehicle is in normal operation, and the free fitting (10, 16) interacts with the positioning means (13, 18, 20, 21).

4. Axle lift system for a road vehicle, comprising an axle having a trailing arm (3) close to each end, which trailing arms (3) are each mounted on a spring hanger (2) which is attached to the chassis (1) of the road vehicle, and wherein a gas suspension system is provided between each trailing arm (3) or the axle (6) and the chassis (1), a fixed support (30), which is fixed to a spring hanger (2), is located beneath a trailing arm (3), a bellows (31) is arranged on said support (30), which bellows (31) can press by means of a seating (34) from below against the trailing arm (3) or a part fixed thereto, for lifting the axle (6) when gas pressure is supplied to the bellows (31) and the gas suspension system is released, characterised in that a bellows according to Claim 1 is provided, the bellows rubber (33) of which interacts, close to the seating (34), with positioning means (32) to hold the bellows rubber (33) in a predetermined position.

5. System according to Claim 3 or 4, wherein the positioning means (13, 32) are fixed to the spring hanger (2).

6. System according to Claim 3 or 4, wherein the positioning means (18) are fixed to the trailing arm (3).

7. System according to Claim 3 or 4, wherein the positioning means (21) are fixed to the chassis (1).

8. System according to one of the preceding claims, wherein the positioning means (13, 32, 18, 20, 21) exert a pretensioning force on the bellows rubber (9, 19, 33) in the direction of its

compressed position.

9. System according to one of the preceding claims, wherein an auxiliary spring (13, 32, 18, 20, 21) is provided, the rigidity of which is greater than the resistance of the bellows rubber (9, 19, 33) to rolling in, which auxiliary spring is fixed by one end to the free fitting (10, 16, 34) and at the other end is fixed to another part of the system.

10. System according to Claim 9, comprising a spring hanger (2) with two parallel spring hanger plates located some distance apart, wherein the auxiliary spring (13) fits with slight play between said spring hanger plates to provide lateral support for said auxiliary spring.

11. System according to Claim 9 or 10, wherein the auxiliary spring is a leaf spring.

12. System according to one of Claims 9-11, wherein the auxiliary spring has a pivot point located in the vicinity of the mounting for the trailing arm.

13. System according to Claim 3 or 4, wherein the positioning means (20) are fixed to the fixed fitting (15) of the bellows (14).

14. System according to Claim 13, wherein a helical spring is provided, one end of which is fixed to the free fitting of the bellows and the other end of which is fixed to the fixed fitting of the bellows.

15. System according to Claim 2, 3, 4, 5, 6, 7 or 8, wherein the positioning means comprise an essentially non-elastic auxiliary arm which at one end is fixed to the free fitting of the bellows and at the other end is pivotably mounted.

Fig-1

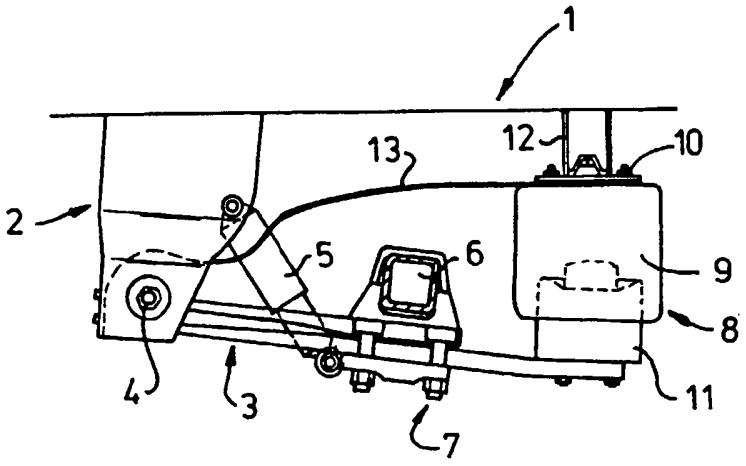


Fig-2

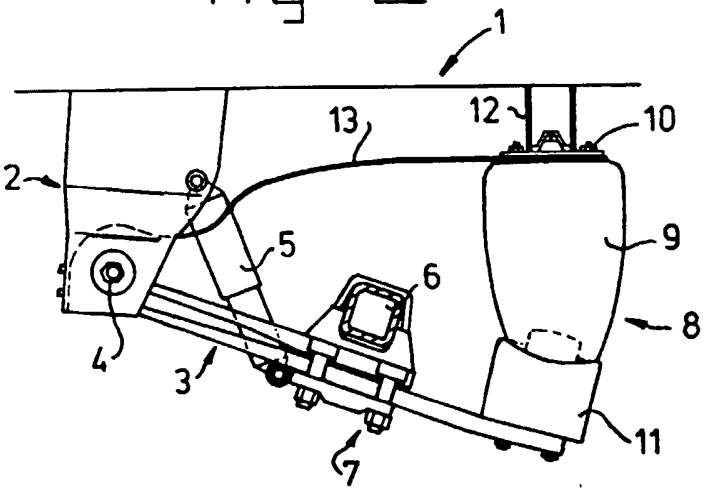


Fig-3

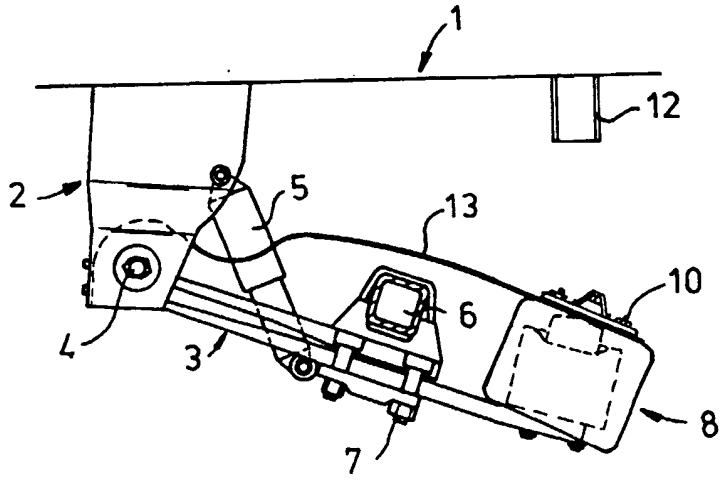


Fig-4

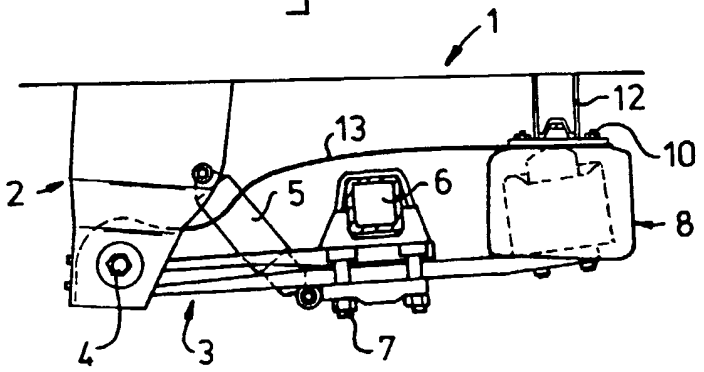


Fig-5

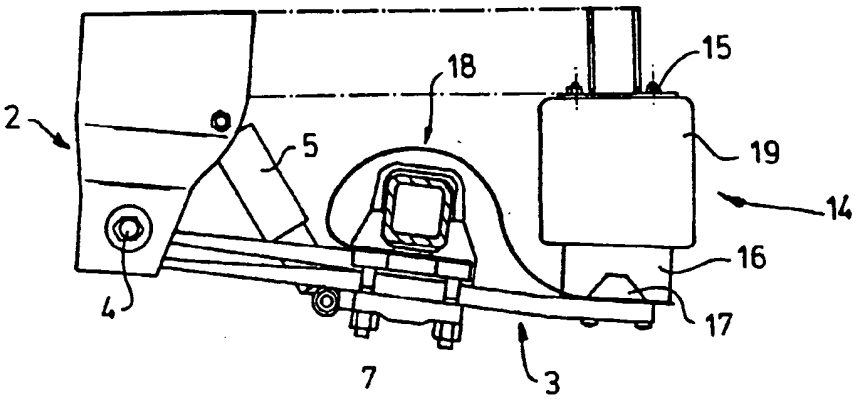


Fig-6

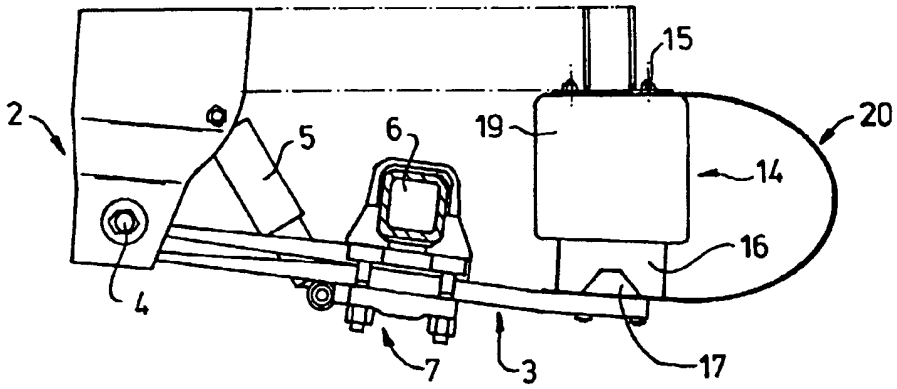


Fig-7

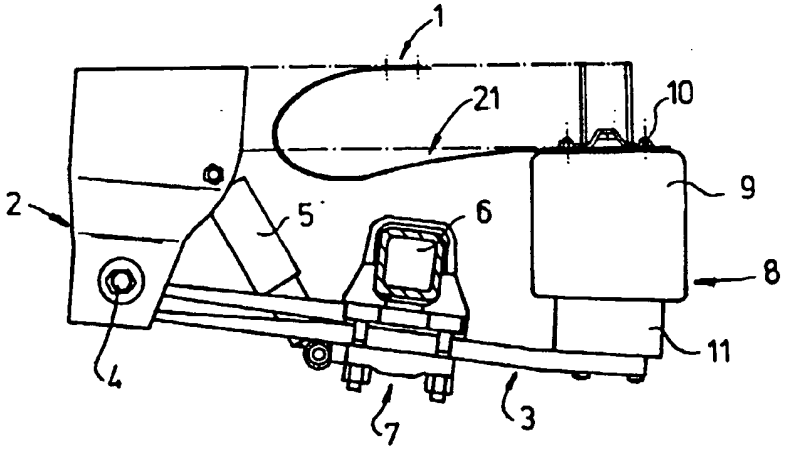


Fig-8

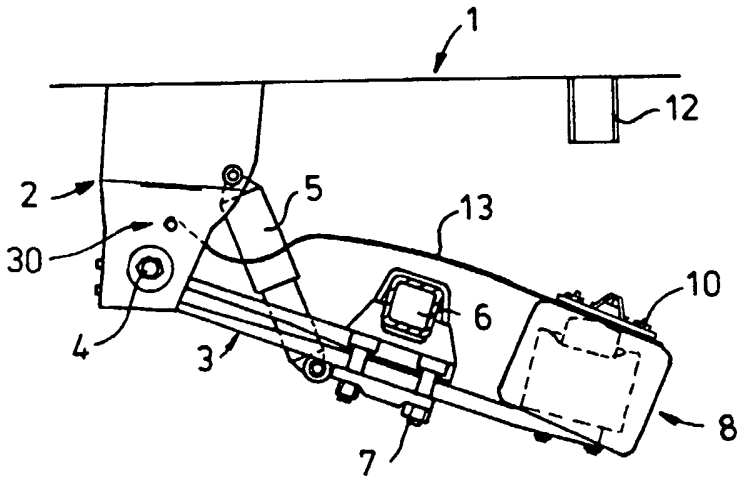


Fig-9